Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	)	
	)	
Streamlining Licensing Procedures for Small Satellites	)	IB Docket No. 18-86
	)	

COMMENTS OF ANALYTICAL SPACE, INC.

Introduction and Summary

Analytical Space, Inc. (ASI) respectfully submits these reply comments in response to the FCC's Notice of Proposed Rulemaking: Streamlining Licensing Procedures for Small Satellites.

ASI is a Cambridge, Massachusetts-based start-up that is building an in-space data relay network.

ASI applauds and supports the FCC's efforts to develop a streamlined process that is more appropriate to the operations of many new entrants than the current Part 25 Non-Geostationary Orbit (NGSO) satellite process. However, as proposed, this rulemaking would create a process that appears to be of limited or no utility to most small satellite operators given the numerous and oftentimes very stringent requirements. There are numerous ways to improve this rulemaking: (1) the rule should operate to encourage innovation and be written clearly to be easily understood by new entrants to the industry; (2) Screening criteria for the streamlined process should be based on the FCC's review burden, rather than proxy standards; and (3) the rule should regulate performance rather than methods.

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I. ASI supports the creation of a streamlined process for small satellites.

As the rulemaking states, the current Part 5 process is not appropriate for many small companies launching small satellites into space. However the Part 25 process can be overly burdensome for these companies, often costing more than the satellite itself.[1] ASI therefore approves of the creation of a streamlined process for these companies and supports the FCC's efforts to that end. In particular, ASI believes the exemption from processing rounds, the proposals for operational debris and risk of collisions, and the proposal of allocation of spectrum for inter-satellite links are appropriate for this rulemaking.

A. Exemption from Processing Rounds.

In the past, the FCC has granted waivers of processing round rules for EESS-operating satellites under the stipulations that they avoid interference and not inhibit the use of the same spectrum by future users.[2] The proposed streamlined small satellite process would exempt qualifying applicants from conventional processing round procedures.[3] This would reduce the length of the process and the burden on both private companies and the FCC, and ASI finds this change to be entirely appropriate.

B. Operational debris and risk of collision.

The FCC proposes that because they must scrutinize whether a satellite will release operational debris, only those satellites planning to release no operational debris for the entire mission duration should be eligible for the streamlined process.[4] Moreover, it is proposed that a satellite's risk of collision be lower than 0.001. These implementations seem acceptable as the

[1] Proposed Rulemaking at paragraph 3
[2] See Proposed Rulemaking at 42
[3] Proposed Rulemaking at 22
[4] Proposed Rulemaking at 37

acceptability of the release of debris would seem to require a more in-depth review than the proposed streamlined process is designed to support.

C. Inter-satellite links.

The Commission proposes to develop an allocation for space-to-space operations in the Mobile Satellite Systems (MSS).[5] This is an appropriate action. In fact, this is a valuable avenue to help address increasing spectrum congestion. Allowing for space-to-space operations would help distribute spectrum usage across less congested parts of an orbit such as when over the ocean. ASI approves of the rules as proposed, but ASI further suggests the FCC should enable greater use of spectrum by adding space-to-space allocations in X-band between 8025-8400 MHz. The 8GHz earth-exploration band, popularly used for remote sensing satellite downlink, is not allocated for space-to-space links. If the 8025-8400 MHz allocation was made to mirror the similar remote sensing bands in lower S-band of 2025 to 2110 MHz and 2200 to 2290 MHz in terms of having the allocation to both space-to-Earth as well as space-to-space, greater use of remote sensing satellites and more innovation would be possible. Additionally, opening up a band that is already used by many operators of high-data operations like remote sensing would allow operators to use their same hardware and thus make inter-satellite links more accessible, given the severe space and power constraints that limit the ability to add additional communication modules on small satellites.

II. The regulation should provide a smooth on-ramp into the industry for new entrants by providing clear guidelines and encouraging innovation.

While ASI approves of the development of the streamlined process for smaller satellites, it believes there are several problems with the regulations as proposed. First, the regulation

[5] Proposed Rulemaking at 72

should provide clear guidelines for new entrants into the industry and should encourage innovation. To the greatest extent possible, regulations should be understandable to a new entrant to the industry. The wave of entrepreneurs over the last few years has helped propel the growth of this industry and it's vital that the on-ramp to the industry is as smooth as possible. Certain aspects of the regulation as proposed are unclear, while other aspects increase, rather than decrease, barriers to innovation.

A. The term used to describe eligible satellites should reflect the characteristics required by the FCC.

The current terminology, "small satellite,"[6] only reflects the size requirements proposed by the FCC, failing to acknowledge other proposed characteristics such as mission duration. "Small satellite" may make the name of the process more compact for industry professionals, but it invites confusion for new entrants who may think they qualify for the streamlined process due to the size of their satellite, when small size is far from sufficient. As such, the current term should be lengthened in this rulemaking and in other FCC references to it to reflect each dimension in which satellites eligible for streamlined processing are defined. A longer title is a preferable alternative to the confusion that is likely to result, especially for new entrants, if an incomplete but more compact title is used.

B. Satellite operators should still be able to utilize Part 5 when appropriate.

Currently, all NGSO Part 25 applicants must abide by the same application and processing fees, regardless of the spacecraft's characteristics. The espoused impetus for the rule-making rests on the challenges of applying the Commission's Part 25 licensing procedure to

[6] *See* Streamlining Licensing Procedures for Small Satellites, Notice of Proposed Rulemaking, IB Docket No. 18-86 (filed March 27, 2018) ("Proposed Rulemaking").

small satellites.[7] In particular, the fees and initial surety bond often exceed the cost of the small satellite systems themselves. Empirically, however, the FCC has also taken issue with the use of Part 5 experimental licenses by commercial companies at times. ASI believes that Part 5 does and should continue to play a vital role for new entrants and therefore the FCC should make it clear that the proposed process will not preclude organizations from availing themselves of Part 5 for experimental and demonstration satellites. ASI notes that even costs of $30,000 for the application, not to mention the bond, present a significant fraction of the total cost of many small satellites and pushing all small satellites through this new process and its associated costs will stifle innovation.

C. Many operators do not need strict interference protection.

The FCC suggests that for some satellite operations, including telemetry, tracking, and command (TT&C), implementing interference protection could be important.[8] However, currently many small satellite operators assume that within the few bands in which satellites operate, there could be some degree of interference. One example of this is the number of organizations that are operating under a non-protection basis under experimental licenses. As noted in the proposed rule-making, the chance of interference is relatively low given that most satellites are not within view of respective ground terminals for the vast majority of each day. In cases where interference might be an issue, operators are typically able to work out solutions with one another. The FCC has not provided evidence of interference causing significant challenges in the past for small satellite operators outside of the MSS and FSS. Creating

[7] Proposed Rulemaking at paragraph 3
[8] Proposed Rulemaking at paragraph 17

additional barriers to entry by implementing unnecessarily stringent noninterference rules within new band allocations would disincentivize operators from applying for small satellite licenses.

D. The number of licenses per organization should not be limited.

The proposed streamlined licensing process would limit the amount of satellites each grantee may deploy to 10.[9] The FCC should not prevent companies from launching several constellations designed to operate differently. There is naturally a barrier to putting in excessive applications with the FCC through the cost of labor required to draft those filings as well as the associated fee for each application, and so a limitation on the number of licenses a grantee may apply for under this process would likely not reduce the FCC's review burden but still stifle innovation. ASI believes there should not be a limit on the number of application submissions through the proposed process.

E. Orbital lifetime should not be limited to five years.

The FCC proposes that applicants interested in the streamlined small satellite process verify that total on-orbit lifetime, including deorbit time, must be less than five years. This proposition is based on the ITU's findings that most nanosatellites operate for one to three years, while other small satellites may operate for up to ten years. Limiting orbital life to 5 years, after accounting for a 2-year buffer due to unpredictable launch schedules and lag in between deployments of different satellites in a constellation, would only allot for approximately three years of operation on orbit. Given that applicants may be approved to deploy up to ten satellites, this would essentially limit companies to launching all satellites approved under a single license simultaneously or otherwise risk that launch delays or other factors outside the control of satellite

[9] Proposed Rulemaking at 27

operators mean certain satellites are able to operate for a small fraction of their operational lifetime. Moreover, there is likely to be a discontinuity created at roughly 3-5 years of on-orbit lifetime given that the difference in costs and burden will propel organizations to seek to keep their lifetimes shorter than that cut-off if at all possible. The rationale for the proposed orbital lifetime limits appears to be based off of ITU findings about the average lifetime currently of small satellites. Given the rapid pace of innovation within the industry, basing a regulation off of the current state does not seem to be a sound approach. ASI suggests that the orbital lifetime cut-off, if there is one, is pegged to the lifetime past which the burden of the review burden of the FCC has a discontinuity or where there is an inflection point that causes the burden to increase rapidly. We believe a standard of up to 10 years, starting from the launch of the first satellite, would be more appropriate as that encapsulates the expected lifetime of satellites, plus a margin, for up to standard sun synchronous orbits that many small satellite operators utilize.

F. The license term should not be limited to five years.

Under anticipation that "most operators would launch and operate all satellites...within a short period of time," the FCC proposes a license term of five years, commencing once the first satellite is placed into its orbit.[10] Yet a 5-year cap on satellite licenses is unreasonable. First, this regulation holds an underlying assumption that satellites can easily launch within a short time frame, without keeping launch delays and general uncertainty regarding launch schedules in mind. Under these circumstances, with approximately 2 years as a buffer for launching all satellites, each spacecraft would only have an orbital lifetime of approximately 3 years. The proposed remedy for this issue, allowing operators to forfeit a license, is an expensive and

[10] Proposed Rulemaking at 29

inappropriate approach. The FCC should not limit its ability to issue extensions in the case of factors out of the control of operators. This is especially important given that most small satellites 'rideshare' at the mercy of the schedule of primary payloads. While several companies are working on "smallsat launchers" that would provide more certainty in planning for smallsat operators, regulations should not be based on the expected availability of a still to be proven option.

G. Replacements and extensions are necessary, at least for events outside the control of operators.

Since grantees have the opportunity to achieve additional licenses under the streamlined process, it is proposed that regulations for satellite replacement or license extensions are not necessary.[11] However, once again, this proposed regulation fails to account for the possibility of launch delays that could cause unanticipated setbacks for operators. Extensions would be very important under these and possibly other circumstances so that grantees are not forced to reapply for licenses and pay an additional $30,000 application fee.

H. The proposed deployment orbit and maneuverability requirements are unjustified and raise significant barriers for operators.

The FCC proposes that applicants must deploy their satellites below the orbit of the International Space Station, set at 400 km; be deployed directly from the International Space Station (ISS) or a docked vehicle; or, if satellites are deployed above the altitude of manned spacecraft, indicate and employ propulsion strategies to avoid potential collision.[12]

The FCC acknowledges that small satellites are limited in orbital placement as a result of being launched as secondary payloads, and mentions that launch vehicle development will

[11] Proposed Rulemaking at 30
[12] Proposed Rulemaking at 33-34

eventually prioritize small satellites as primary payloads. However, until those launch vehicles that prioritize small satellites are more accessible and reliable, it is unreasonable to expect that small satellite operators would not pursue ridesharing options as the primary mechanism for reaching orbit. Since small satellites can be expected to continue ridesharing, it's important to consider that altitude restrictions would implicate the ability of small satellites to be placed near the same orbits as larger, primary payloads.

In addition, precedent approval from NASA of higher altitude missions, in tandem with a low risk of collision with manned spacecraft, indicates that requiring the use of propulsion technology aboard small satellites deployed at an altitude above 400 km is unnecessary. Empirically, NASA has approved of satellites indicating a launch altitude of 400 km or higher without propulsion on board.[13] In short, the need for this rule does not seem to be justified and is far from without cost to smallsat operators.

I. The proposed casualty risk requirements should be clarified and small satellite operators should have to abide by same orbital debris standards as other operators.

The FCC's current procedure requires applicants to assess casualty risk by accounting for both the risk of human casualty and probability of debris surviving re-entry. The Commission proposes that small satellites must conduct a risk assessment using NASA's Debris Assessment Software or similar that results in a human casualty risk of zero in order to be eligible for streamlined processing. The FCC should be more precise in defining the threshold at which a casualty risk assessment produces a nonzero output that is sufficiently low as to be rounded to zero. Additionally, ASI believes that small satellites, and specifically those licensed through the

[13] NASA-Sponsored CYGNSS Mission is one example - https://directory.eoportal.org/web/eoportal/satellite-missions/c-missions/cygnss

proposed process, should be held to the same orbital debris standards as other satellites. If there is to be a change in the standards, ASI believes that should be handled in a separate orbital debris rule-making and be applicable to all satellites.

J. There should be no bond requirement for the streamlined process.

In lieu of imposing the bond agreement authorized under Part 25, the FCC proposes the implementation of a one-year "grace period" that allots qualifying small satellites the ability to operate without posting a bond.[14] ASI does not believe a bond is necessary for this process since no spectrum rights are granted.

K. The requirement to deploy within the one-year grace period is unreasonable.

The FCC proposes that grantees who fail to deploy authorized satellites within the allotted one-year grace period may choose to either comply with the current bond requirements under Part 25, or choose to surrender their licenses to avoid paying the bond requirement.[15] While ASI does not believe there should be an associated bond for this process as noted above, if there is to be one, this one-year cut-off is not aligned with the common realities of small satellites. Despite the growth of companies looking to develop dedicated smallsat launchers, the current reality and expected bulk of opportunities for small satellites is via rideshares. As discussed above, small satellites on rideshares are subject to the whims and scheduling of the primary payload and can have the launch schedule moved through no fault of the smallsat operator. Imposing a one-year deadline on operators who may be incapable of meeting that deadline through no fault of their own will only stifle innovation in this industry.

L. Limiting small satellites to certain frequencies beyond what is done by class of service in the table of allocations could discourage innovation.

[14] Proposed Rulemaking at 50
[15] Proposed Rulemaking at 53

The FCC seeks comment on the authorization of specific frequencies for satellite services operations.[16] Allocating specific frequencies, beyond what is already stipulated by the various classes of service in the table of spectrum allocations, may impede innovation as it would restrict uses. That said, if there are any frequencies for which it is known applicants won't get approved, those should be expressed clearly to make it easier for new entrants to plan and not waste precious resources on frequency dead-ends. ASI does support an update to FCC DA 13-445 to provide a suggested but non-exclusive listing of frequencies.

III. Screening criteria for satellites should be based on the FCC's review burden rather than proxy standards.

This proposed rule has numerous aspects of a satellite from size to orbital lifetime and others that would serve as screening criteria for which satellites could fall under the proposed process. In some cases, these appear to be proxies that do not in fact impact the FCC's review burden. Proxies are, by definition, somewhat inaccurate approximations and should be avoided.

A. Maximum size.

With guidance from the definition provided by NASA, the FCC proposes to limit spacecraft size to 180kg.[17] In our view, other standards within this proposed rulemaking would make this cut-off largely extraneous - in other words, satellites would hit at least one other cut-off that forced them out of this streamlined process before they hit this maximum size. The larger issue though is that the size cut-off and the screening criteria in this rulemaking as a whole are imperfect proxies for what the FCC is trying to do which is align the costs to applicants of a process to the costs incurred by the FCC to review to ensure compliance with regulations and the

[16] Proposed Rulemaking at 57
[17] Proposed Rulemaking at 32

efficient use of spectrum. In that case, aspects of a satellite that help reduce FCC review burden, based on ASI's understanding, include:

- Orbital lifetime - shorter and more predictable lifetimes would be less of a burden (although as noted above, the current proposal may not be proper).
- Debris characteristics - specifically is the satellite made up of standard materials that can be expected to burn up upon re-entry or not
- Need to operate on a protected spectrum basis - willingness to accept some interference and/or limit operations to specific areas would reduce burden

Size is an imperfect proxy for lifetime and debris, and use of such proxies when there are more direct methods of assessment accessible, such as orbital lifetime projections, does not seem like a wise path. Unless there is a reason ASI is unaware of that directly ties the size of the satellite to the review burden of the FCC, ASI believes that the size cut-off should be removed.

IV. The FCC should regulate performance rather than methods.

Regulations are, by their nature, fairly rigid, and if methods of achieving a goal are set in regulation, they can be quickly obsoleted by technology. It is a preferred path, especially in the very fast evolving space industry, to regulate performance rather than prescribe the method to achieve the goal.

A. Trackability.

The FCC proposes that all applicants abide to maintaining that their satellites are no smaller than 10 cm per side.[18] However, as technology continues to develop, it is plausible for satellites that exceed this size threshold to be trackable. The metric used to restrict trackability

[18] Proposed Rulemaking at 38

should be more appropriate than size. Regulations are naturally difficult to update and it's best to have regulations state objectives while not specifying a given approach to satisfy. The rules should state that a satellite is trackable rather than specifying the means of achieving that approach.

V. Additional comments.

A. Optical communications.

The proposed rulemaking mentions 'optical links' as a possible point of discussion for this rule-making, in the context of allowing higher-bandwidth links. ASI does not believe optical or laser[19] communications should be addressed as part of this rule-making. Given the relatively young technical state of optical links and low market penetration amongst small or cubesats, ASI does not believe their existence should drive the availability of RF spectrum for small satellites. This is especially true given the technical requirements for incorporating optical links that make it impractical for many satellites at this time.

While the proposed rule does not specify regulations on optical communications, given their mention, we believe it is valuable to mention that such communications are not covered in the Table of Spectrum Allocations[20] and there is no current reason for them to be.

[19] "Optical" and "Laser" are sometimes used interchangeably when it comes to satellite communications but they are distinct and neither is a great description of many systems. "Optical" refers to the use of wavelengths in the human-visible part of the electromagnetic spectrum (~400-700 nm). "Laser" refers to a specific method of generating a coherent beam of photons, in the optical part of the spectrum or outside of it. Satellite "laser comm" or "optical comm" systems are generally in the infrared, and therefore non-visible to the human eye, part of the spectrum at either ~1040 nm or 1550 nm due to relatively low atmospheric absorption at those wavelengths. These systems would be best described as "infrared lasers" but that is often shortened to just "laser" or expressed as "optical" even though those terms can lead to confusion.

[20] FCC ONLINE TABLE OF FREQUENCY ALLOCATIONS
https://transition.fcc.gov/oet/spectrum/table/fcctable.pdf

Optical communication terminals have beam divergences measured in tens of microradians resulting in negligible chances of interference, especially when the very limited time that they are operational over the course of a satellite's orbit is factored in.

In short, there is no current motivating reason for an additional regulatory burden to be placed upon optical links and thus they should not be considered at this time, including as a part of this rule-making.

Conclusion

ASI supports the FCC's efforts to design a process better tailored for new satellites and systems. Yet there are numerous issues with the rules as proposed. The rules should be clear and easy to understand, and they should encourage, not stifle, innovation in the industry. Proxy screening criteria should be avoided in favor of screening criteria related to the FCC's review burden, and satellites should be regulated based on performance rather than methods. In closing, ASI thanks the FCC for the opportunity to participate in the rulemaking process on issues of paramount importance to our organization.

Respectfully submitted,

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